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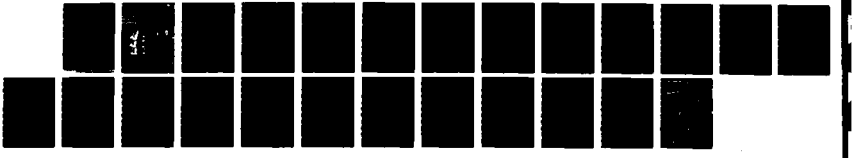

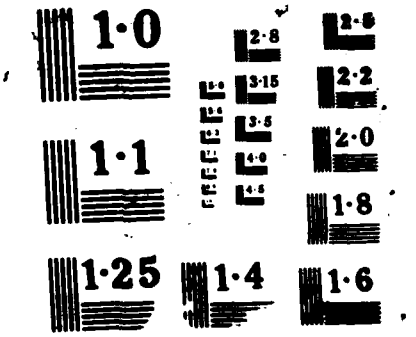
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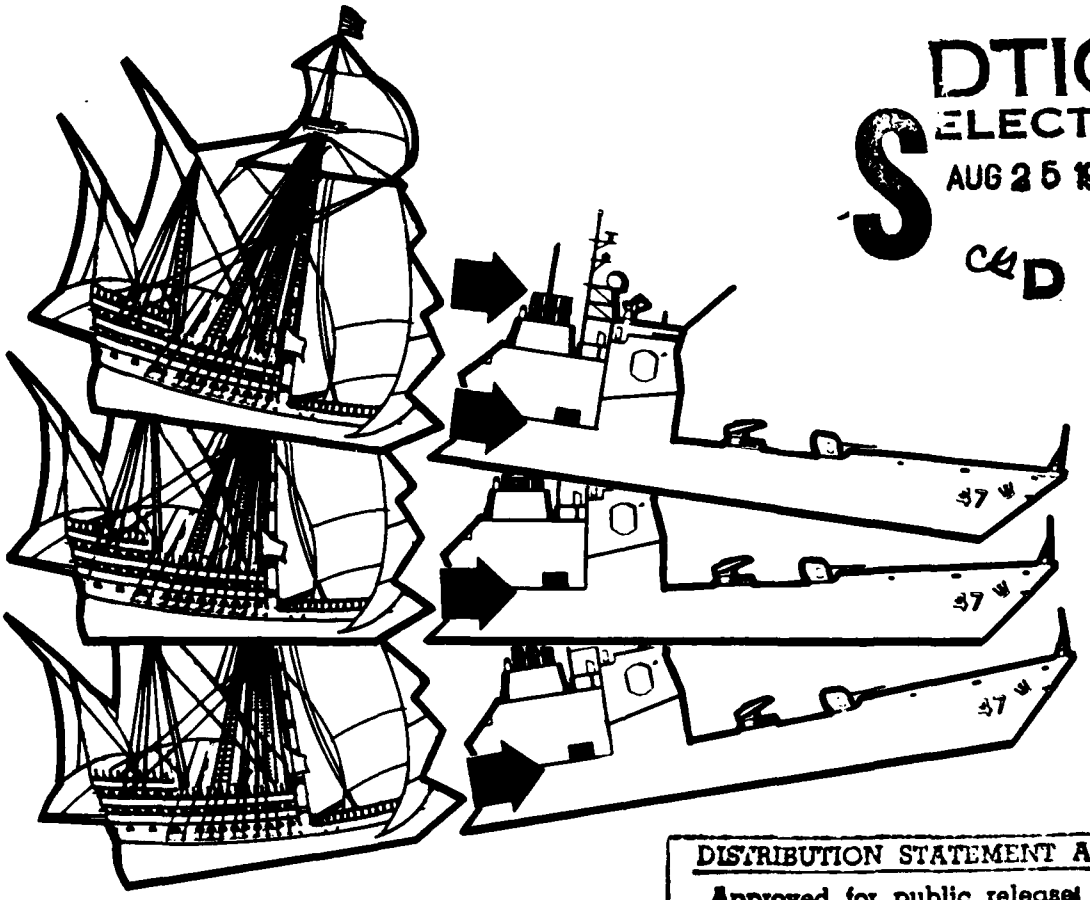

COMPUTER AIDED LOGISTICS SUPPORT — A PROGRAM OVERVIEW

by: Mr. Robert Calogero, and Mrs. Joyce DeTolla

ASSOCIATION OF SCIENTISTS AND ENGINEERS OF THE NAVAL SEA SYSTEMS COMMAND • DEPARTMENT OF THE NAVY • WASHINGTON, D.C. 20362

COMPUTER AIDED LOGISTICS SUPPORT - A PROGRAM OVERVIEW

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MARCH 1987

ABSTRACT

The Computer Aided Logistics Support (CALS) Program is a challenging Department of Defense-wide initiative to achieve major improvements in supportable weapons system designs and logistic technical information. These improvements will result from a transitioning away from a paper-intensive weapon system support process to a largely automated and integrated operation - with substantial implementation of CALS by 1990.

This paper presents a description of the Computer Aided Logistics Support Program, from top level DoD objectives to "desk-top" CALS software for use in NAVSEA. Discussed in this paper are both management and technical issues of this inter-services program; management of the NAVSEA CALS program; methods and approaches for integrating logistics and technical data requirements into the design and engineering process; proposals for re-defining and streamlining data requirements and acquisition to maximize use of automated technologies; and transferring technical and logistics information in digital form. Current computer demonstration projects and candidate CALS software are described.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	DOD CALS PROGRAM	1
3.0	NAVSEA CALS PROGRAM.	6
4.0	NAVSEA CALS PROJECTS AND DEMONSTRATIONS.	8
5.0	CONCLUSION	12
	REFERENCES	13

LIST OF FIGURES

Figure		
1	Standards for Automation of Logistics Technical Information	14
2	Navy CALS Implementation Management	15
3	Generic CALS of the Future	16
4	SSN-21 Demonstration Project Milestones	17

ABBREVIATIONS

ADEPT	- Analysis-Based Data Exchange for Publications and Training
AIM	- Authoring of Instructional Material
CAD/CAM	- Computer Aided Design/Manufacturing
CAE	- Computer Aided Engineering
CAISD	- Computer Aid for Instructional Systems Development
CALS	- Computer Aided Logistics Support
CDRL	- Contract Data Requirements List
DDN	- Defense Data Network
DOD	- Department of Defense
DTNSRDC	- David Taylor Naval Ship Research and Development Center
FMPMIS	- Fleet Modernization Program Management Information System
IDA	- Institute for Defense Analysis
IDSS	- Integrated Diagnostic Support System
ILS	- Integrated Logistic Support
IMA	- Intermediate Maintenance Activity
LAN	- Local Area Network
LSA	- Logistic Support Analysis
LSAR	- Logistic Support Analysis Record
MAP	- Manufacturing Automation Protocol
NBS	- National Bureau of Standards
R&M	- Reliability and Maintainability
SAMIS	- Ship Alteration Management Information System
SEAADSA	- Naval Sea Systems Command Automated Data Activity
SHARP	- Standard Hardware Acquisition and Reliability Program
SUPSHIP	- Supervisor of Shipbuilding
TLRN	- Technical Logistics Reference Network

1.0 INTRODUCTION

The Department of Defense (DOD) has launched a Computer Aided Logistics Support (CALS) Program that has a large potential impact on the scientific and engineering community involved in weapons system R&D, acquisition, and life cycle support activities. When fully implemented for weapons systems acquisitions in the 1990s, CALS will redefine the business of acquiring, generating, and using weapons system technical information in as profound a manner as CAD/CAM is redefining the weapons system design and manufacturing business today. This paper presents a description of the CALS Program with particular emphasis on its implementation within the shipbuilding and ship system acquisition and support context. Beginning with a broad summary of the overall DoD CALS Program, the paper presents the more detailed management and architecture planning activities being conducted by the Naval Sea Systems Command (NAVSEA), and concludes with a detailed description of NAVSEA CALS development and demonstration projects.

2.0 DOD CALS PROGRAM

Program Background

In April 1984, the Under Secretary of Defense (Research and Engineering), and the Assistant Secretary of Defense (Manpower, Installations and Logistics) jointly tasked the Institute for Defense Analyses (IDA) to develop a DoD-wide strategy and recommended master plan for Computer-Aided Logistics Support (CALS).

The Joint Industry-DoD CALS Task Force recommended (reference (1)) that, working in cooperation with the defense industry, other government agencies, and professional and industrial associations, the Department of Defense should take immediate, positive action making use of current and emerging computer technology to:

- Design more supportable weapon systems.
- Transition from paper-based to digital logistics and technical information.
- Routinely acquire and distribute logistics and technical information in digital form for new weapon systems.

The strategy recommended by the CALS Task Force provided a phased program of individual initiatives designed to support achievement of these CALS objectives.

The Task Force recommended that a DoD policy be established that will both direct and encourage the integration of existing "islands of automation" and facilitate the transition of logistics processes within DoD and industry from a paper-based to a digital mode in an orderly way. The policy should stress the need for each DoD component to develop a phased plan for:

- o Demonstrations and incentives to integrate R&M into CAE/CAD, and to automate supportability design analysis.
- o Adoption of DoD-wide interfacing standards and neutral data formats.
- o Instituting pilot programs to integrate selected logistics functions into segments of a CALS process while concurrently requiring that weapon program new starts plan to utilize digital support data.
- o Establishing DoD-wide coordination toward a planned CALS architecture.

For each of these thrusts a plan of action was developed.

A Deputy Secretary of Defense memorandum of 24 September 1985 approved the Task Force, established a top-level CALS Implementation Steering Group and provided CALS implementing guidance to the Military Departments and DoD Agencies (reference (2)).

Congress has maintained continued interest in the application of advanced computer technologies to reducing the costs and increasing the effectiveness of logistics support. Specific recommendations, indications of this interest have included:

- o The Defense Procurement Reform Act of 1984 contained a number of provisions with impact on logistics technical data. Key among them is the requirement for DoD to establish a Department-wide locator system for engineering drawings and technical data.
- o The Senate Appropriations Committee Report on the DoD Appropriations Bill of 1985, requested a report from the Navy on potential for expansion of CAD/CAM techniques at Naval shipyards and engineering centers.

- The House Appropriations Committee Report on the DoD Appropriations Bill, 1986, expressed concern for the potential lack of integration of multiple data automation initiatives being pursued by the Services and directed DoD to establish common electronic publishing standards and specifications, develop an overall plan for compatible automated digital systems for use within DoD and for a 50% reduction in the use of paper technical documents.

CALS Technical Background

A fundamental premise upon which the CALS Program is based is the recognition that the computer technology exists today to support dramatic improvements in the way the Integrated Logistics Support (ILS) discipline is imposed throughout the weapon system life cycle. Computer-based solutions that were previously too expensive and difficult to use as replacements for current paper-based process are now affordable and "user-friendly". Almost all of these maturing computer technologies are directly applicable to the DoD logistics infrastructure. Although by no means complete, any list of these technologies would include:

- High-resolution color graphics
- Optical disk main storage
- Local area networks
- Wide Area Networks/Intelligent Gateways
- Electronic publishing
- High speed, high quality laser printers
- Expert systems software
- Fourth generation program development and database management tools
- OCR-based input devices
- Voice recognition systems.

One major thrust of the DoD CALS Program is to provide incentives to weapon systems contractors and direct DoD components to use these technologies to improve weapon system design and support. While this objective is laudable, there exists a danger in limiting the scope of CALS to uncontrolled technology proliferation. The danger is in perpetuating and expanding the "islands of automation" that already exist to some extent today. A private industry analogy to this problem is the difficulty that automobile manufacturers have faced in turning factory automation initiatives into a truly Computer Integrated Manufacturing environment. General Motors Corporation has enacted a comprehensive solution to this problem through its Manufacturing Automation Protocol (MAP), a set of data communication standards that will integrate each automated process. An integral thrust of the DoD CALS Program will

involve a similar solution process. Through a coordinated effort between DoD, the National Bureau of Standards (NBS), and industry, the DoD CALS Program will research and evolve a set of functional, database, and computer technology standards for industry and DoD use when CALS is fully implemented.

As part of the NBS support for the DoD logistics environment, NBS has established the following logical grouping of standards for automating logistics technical information:

o Information Exchange - those standards which describe the transfer of information between different systems and the media on which transfer occurs.

o Information Services - those standards which define services pertaining to the location, verification, organization and presentation of information.

o Applications Systems - those standards which refer specifically to the complex application areas of automated manufacturing, office automation, and business automation.

o Programming Environment - those standards relating to the process of creating, testing, and documenting programs.

Figure 1 portrays this NBS taxonomy and shows the specific applications of standards in each group. These standards will form the basis for a CALS "control architecture" that will make the different hardware and software configurations transparent to the users of digital logistics and technical information.

In summary, the technical objectives of CALS are two-fold; (1) rapidly inject current and emerging computer technologies into the weapons system logistic business, and (2) define a control system that builds "digital bridges" between technologies.

DoD CALS Management Structure

The DoD CALS Program Management structure is led by a DoD CALS Steering Group consisting of senior DoD, service, and agency executives. The group reports to the ASD (A&L) on a quarterly basis. The DoD CALS Steering Group receives technical support from staff elements of the Office of the Secretary of Defense, the Services, the Defense Logistics Agency, the Defense Communications Agency, and the Joint Logistics Commanders. The OSD CALS office, under the direction of the chairman of the DoD CALS Steering Group:

o Coordinates CALS integration efforts.

- o Coordinates development of common data interchange standards.

- o Develops evaluation documentation for Service program compatibility, commonality, and consistency.

- o Provides an interface with industry.

- o Responds to Congressional interest in the DoD CALS program.

Military Department/Agency Initiatives

The DEPSECDEF September 1985 "CALS Action Memorandum" formally committed DoD to the CALS Program and provided initial CALS implementation guidance to the services and agencies. In particular, the memorandum directed DoD components to develop implementation plans that emphasized the following tasks:

- o The designation or establishment within the Military Department and Agencies of a central organization with broad responsibility for all aspects of CALS implementation, including information system architecture, information exchange standards, and resource oversight of related data automation modernization and demonstration projects.

- o Comprehensive plans for modernization of government information processing capabilities, commencing with key logistic technical information repositories, communication nodes, and publishing centers, to achieve an early capability to accept, process, access, and distribute contractor logistic technical information in electronic form.

- o Establishment of a schedule with specific milestones for revising applicable military specifications and standards to provide for acquisition of logistic technical information in digital form. First priority during the next two years should be given to specifications and standards for engineering drawings and technical manuals. The interim data exchange standards identified above will be included in near term implementation of these specifications to facilitate hardware independence.

- o Implementation of demonstration projects over the next four years in which engineering drawings, technical manuals, and logistic data for selected weapon systems and equipment will be created, stored, distributed to DoD users, and updated using electronic formats. The demonstrations will emphasize data integration, and

will be structured both to demonstrate the advances possible in the performance by government and industry of specific system design. Data exchange standards, common data element formats, component designation, reference numbering techniques, communication requirements, safeguards for classified and proprietary data, and other issues developed in the CALS recommendations should be explored through these demonstration projects.

- Review of current new weapon system acquisition programs to take advantage of near term and long term automation opportunities for the production, delivery, and use of product definition data and logistic technical information. All new major weapons systems approaching production by the end of this decade or beyond should be reviewed now, and plans and contract requirements should be structured for receipt and distribution of logistic technical information products in digital form. Less-than-major systems should follow this lead to the extent feasible.

- Identification of long haul communications and wide area networking requirements for CALS implementation. The Defense Communications Agency will review peace and wartime requirements with the Military Departments and Agencies, and will plan to include the necessary capabilities in the Defense Data Network (DDN).

- Establishment of a technology development program. The Defense Advanced Research Projects Agency will work with the Military Departments and Agencies to identify and prioritize technology issues associated with CALS implementation.

In response to the implementing guidance, the Navy Department established a CALS Senior Navy Steering Board (SNSB) under the direction of the Assistant Deputy Chief of Naval Operations (Logistics). (The Navy CALS Implementation management structure is depicted in Figure 2). The CALS SNSB, working closely with NAVSUP (PML 550), the lead SYSCOM CALS Coordinator, promulgated a draft Navy CALS Implementation Plan in July 1986. The Navy CALS Plan is currently undergoing final revisions to be responsive to the DoD CALS Coordination Office. NAVSEA has had significant input to the Navy CALS Plan and has been established as the CALS Manager for shipbuilding and ship combat system applications.

3.0 NAVSEA CALS PROGRAM

Management

The Deputy Chief Engineer for Logistics (CHENG-L) is the Command Manager for the NAVSEA CALS program and provides oversight and guidance for CALS related programs. Specific NAVSEA CALS Program responsibilities of CHENG-L include:

- o Be responsible for Command-wide oversight, policy, integration, and management of the overall NAVSEA CALS program;

- o Represent NAVSEA on the Senior Navy Steering Board and at other high activities for all CALS matters;

- o Establish methods to screen all command efforts which fall under the scope of CALS, and coordinate those CALS efforts being executed by various directorates;

- o Establish a means to ensure integration and interoperability of all CALS efforts including development, adaptation, tailoring, and implementation of standards, formats, and specifications as appropriate; and proof of principle through use of demonstration programs;

- o Establish a working group to guide the implementation of CALS within NAVSEA activities;

- o Develop and maintain a command CALS program plan and overall NAVSEA CALS architecture;

- o Issue a POA&M to establish the necessary guidance for CALS development and implementation.

CHENG-L also has management direction over the Lead CALS Development Library, the David Taylor Naval Ship Research and Development Center (DTNSRDC). DTNSRDC's planned role is to test proposed CALS standards and software and ensure that data standards, data storage, and data communication are compatible and meet the requirements for the DoD-wide CALS architecture.

CALS Architecture

The overall objective of CALS is to integrate and improve the logistics function through the efficient application of computer technology. Implicit in this objective is a substantial shift from current paper intensive processes to a highly automated mode of operation. The major CALS challenge is to develop compatible information system architectures in DoD and industry that can be rapidly implemented without incurring excessive costs. These architectures must be responsive to the three major CALS objectives described in the DoD CALS Program Background section.

The OSD CALS office is currently developing "core" CALS requirements packages to guide individual service CALS architecture development. In an effort to support DoD planning activities in this area, NAVSEA has developed a "Generic CALS of the Future" map that defines a preliminary vision of a CALS architecture oriented to the shipbuilding and ship support environment (see Figure 3). As can be seen, this map

specifically addresses the three CALS objectives and displays the digital interfaces envisioned to transition to a "paperless" way of doing business. Following receipt of additional DoD/Navy guidance (expected in early 1987), NAVSEA will refine this map into a comprehensive CALS architecture. The approved architecture should define the CALS system of the 1990's. All future NAVSEA implementation activities will be aimed at achieving this "end state" capability.

DoD has recognized that the process of deriving a CALS architecture is complex and requires significant mobilization of DoD components and industry. To gain valuable momentum for the CALS Program while the process takes place, two other management efforts are underway. These efforts are (1) the identification and integration of proposed or ongoing technical information automation projects, and (2) the planning and execution of lead weapon system demonstration programs. These initiatives, which are the primary focal points of NAVSEA actions today, are discussed in the succeeding section of the paper.

4.0 NAVSEA CALS PROJECTS AND DEMONSTRATIONS

Lead NAVSEA Projects

The CALS Senior Navy Steering Board implementation planning efforts included the identification and classification of planned and ongoing Navy automated technical information projects that could be used as CALS "test beds" for further architecture planning. Twenty-seven Navy projects were selected as core CALS Baseline Projects in the draft Navy CALS Implementation Plan. NAVSEA is the lead SYSCOM for twelve of these projects. Each of the projects is briefly summarized in the following paragraphs.

Navy Integrated CAD/CAM

This project will facilitate CAD/CAM system integration by using a single set of specifications and reduced duplicative staff management effort in their development.

Computer-Aided Technical Information System (CATIS)

Quality optical disk and related technology for application aboard nuclear powered submarines and at their principal shore and afloat support sites. Specific applications to be considered include engineering drawings and technical manuals. The desired result is eliminating the inefficiencies of current shipboard and repair facility technical data storage, retrieval and use processes.

Authoring of Instructional Material (AIM)

The objective of AIM is to develop an automated prototype system for the development, generation, preparation, and production of instructional materials for courses. The system project will evaluate various automated instructional development processes and compare their effectiveness to conventional methods of curriculum development.

Computer Aid for Instructional Systems Development (CAISD)

Current methods of developing and maintaining training curricula are largely manual. Automation of training curricula life cycle maintenance will reduce the time required to generate changes, improve quality of training materials and reduce costs.

Analysis-Based Data Exchange for Publications and Training (ADEPT)

This project will apply expert system logic to the integrated development of training and technical manual materials. It emphasized the logical, coherent development of data materials, and creation of audit trails to assure the currency, consistency, and relevancy of data products to related source data. The outputs will be in formats compatible with CATIS, CALSA, and other CALS requirements.

Automated Ship Documentation

This project will apply advanced data management, reproduction, and distribution techniques for the creation of integrated, automated logistics data repositories. Automation of ships logistics technical data will permit update and retrieval of source ships data to support ships corrective and planned maintenance, provisioning, configuration control and training functions.

Technical Logistics Reference Network (TLRN)

The TLRN is a distributed processing system which is accessed through microcomputers throughout the country. TLRN has complete information on any part or component within the Federal Supply System that can be retrieved by various index keys or technical characteristics defined by the user.

Fleet Modernization Program Management Information System (FMPMIS)

FMPMIS is a modernized automated data processing system designed to support fleet planning, programming, budgeting and execution of ship class military and technical alterations. FMPMIS replaces the Ship Alteration Management Information System (SAMIS).

Naval Sea Systems Command Automated Data Activity (SEAADSA) Local Area Network (LAN)

The SEAADSA LAN supports central design agency activities for Naval shipyards, weapon stations, ordnance stations, SUPSHIPs, PERA, and NAVSEA headquarters. DDN will be used as the long distance network to connect these LANs. SEAASDA is responsible for NAVSEA computer design, programming and equipment specification and selection.

Integrated Diagnostic Support System (IDSS)

This provides a maintenance capability matched to technician skill and availability for the detection and unambiguous isolation of all faults know or expected to occur in weapon systems. Anticipated IDSS benefits include a doubling of technician productivity and reduction of MTTRs by 90%.

Standard Hardware Acquisition and Reliability Program (SHARP)

SHARP involves the development and testing of functionally standard modules designed to utilize new materials required to support high concentrated power and thermal dissipation of new VHSIC/VLSI components. The program incorporates CAD/CAM and related tools and will improve operational readiness. It will also reduce development production and support costs of applicable weapon systems.

Ship CAD/CAM

This project will install CAD/CAM stations at Naval shipyards, ordnance stations, SUPSHIPs, and engineering units to support the design, maintenance, and modification of ship weapons systems and equipments. This is expected to produce substantial improvements in ship acquisition and logistics support costs, time and product quality through reductions in change orders, improved product design and decreases in drafting and bills of materials preparation efforts.

A major FY-87 objective of NAVSEA CHENG-L will be to assess and integrate these lead NAVSEA CALS Projects into the evolving CALS architecture. The other major FY87 activity directly under CHENG-L control is the SSN-21 demonstration project discussed in the following section.

SSN-21 CALS Demonstration Project

The SSN-21 class submarine program provides an ideal opportunity for an end-to-end CALS demonstration. The SSN-21 is the first submarine design in which the Navy has tasked contractors to introduce producibility as a major consideration during the up-front design process. Two major processes have been used to this end--modular construction and computer-aided

engineering and design. The SSN-21 program will serve as lead platform for demonstrating major portions of a total CALS process. This baseline will be augmented by selected projects from the above list which will eventually be integrated into the SSN-21 baseline system. The baseline will be used to validate specific technology applications within a total CALS process for eventual transfer of principle and application to other NAVSEA programs.

The central design agent for the SSN-21 (Newport News Shipbuilding) will be the lead activity for demonstration planning and execution. A multidiscipline, multi-organization (Navy and industry) "CALS TEAM" has been established to provide program and technical management support. The payoff sought is a CALS "template" consisting of generic functional specifications, architectural guidelines and validated standards which could be transferred to other Navy/Service requirements.

The specific SSN-21 demonstration approach will involve the automated development and subsequent utilization and electronic transmission of information from design and ILS databases to a range of Navy and contractor personnel. A phased building-block approach is envisioned whereby CAD/ILS data exchange among shipyards and Navy offices is demonstrated, as well as controlled database access upon request of personnel with access to automated systems. Moreover, the product model CAD/CAE database will be used in part to generate the automated ILS database for subsequent expedited generation of the LSA/LSAR process. An architecture, based on the planned information system requirements of the SSN-21 and its Logistics Data System, will be developed to satisfy information requirements of the following activities: NAVSEA, Supervisor of Shipbuilding, Fleet units, training organizations, the Navy centralized configuration management system, IMAs, and private and public shipyards. Specific demonstration elements include:

- development of the product definition model and incorporation of on-line R&M and testability analysis consistent with the design process
- demonstration of the use of the automated CAD/ILS data base to generate technical publications and technical illustrations
- use of neutral data formats for interchange of digital data
- automated LSA/LSAR consistent with the needs of the SSN-21 logistics data system and the technology envisioned for its development and maintenance, including candidate Unified Data Base 2000, CALSA, COBOL and IDMS capabilities

- o automated production of training curricula information using the ILS data base
- o automated diagnostics authoring.

The major milestones planned for the SSN-21 demonstration program are depicted in Figure 4.

NAVSEA (CHENG-L) is working closely with the Attack Submarine Acquisition Program Directorate (PDS 350) and the SSN-21 Acquisition Manager (PMS 394) to achieve measurable in-house NAVSEA benefits through this demonstration project. Innovative methods of structuring the SSN-21 Contract Data Requirements List (CDRL) have been applied to allow several specific logistics and design data products to be transmitted digitally to NAVSEA. The demonstration data base and network will consist initially of an ALTOS 3068 computer system employing the UNIX operating system. The network will include terminal access at CHENG-L, PDS-350, and PMS-394 offices. Additional links are planned for other NAVSEA offices as the demonstration project progresses. Terminal access will be supported by sophisticated fourth generation data base software and by application of interim CALS data communication and text/graphics standards.

5.0 CONCLUSION

Over the last fifteen months following DoD's formal commitment to the CALS program, great strides have been made in laying the groundwork for aggressive implementation of CALS. As one of DoD's largest weapons system procurement activities, NAVSEA has played a major role in this implementation planning effort. Although dedicated CALS funding at this point is relatively small, FY 87 development and demonstration projects will set the stage for major development efforts in the next several years. As these efforts expand, all NAVSEA organizations will play a larger role. Command awareness and support of the CALS Program is vital to making these efforts successful. The payoff for all of us involved in the ship and ship system development, acquisition, and support business will be substantial, particularly when we reflect on the frustrations in dealing with the current "paper machine." The CALS Program promises to be an exciting and rewarding effort to which each of us can contribute and from which we can better fulfill our mission of building and supporting the most capable Navy in the world.

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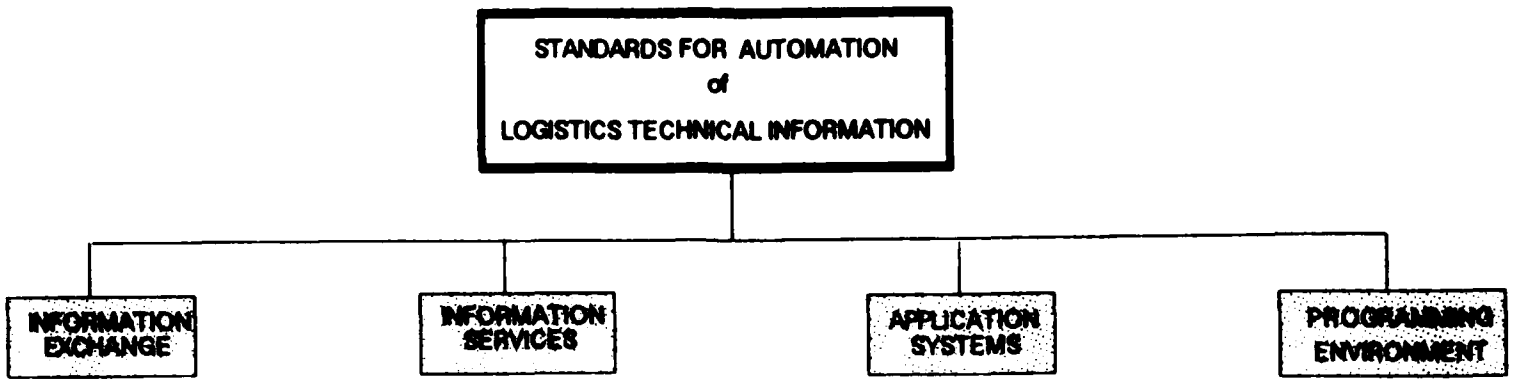


- o DATA REPRESENTATION
- o MEDIA
- o COMMUNICATIONS

- o DATA BASE
- o DATA DICTIONARY
- o GRAPHICS

- o OFFICE AUTOMATION
- o INDUSTRIAL AUTOMATION
- o BUSINESS AUTOMATION

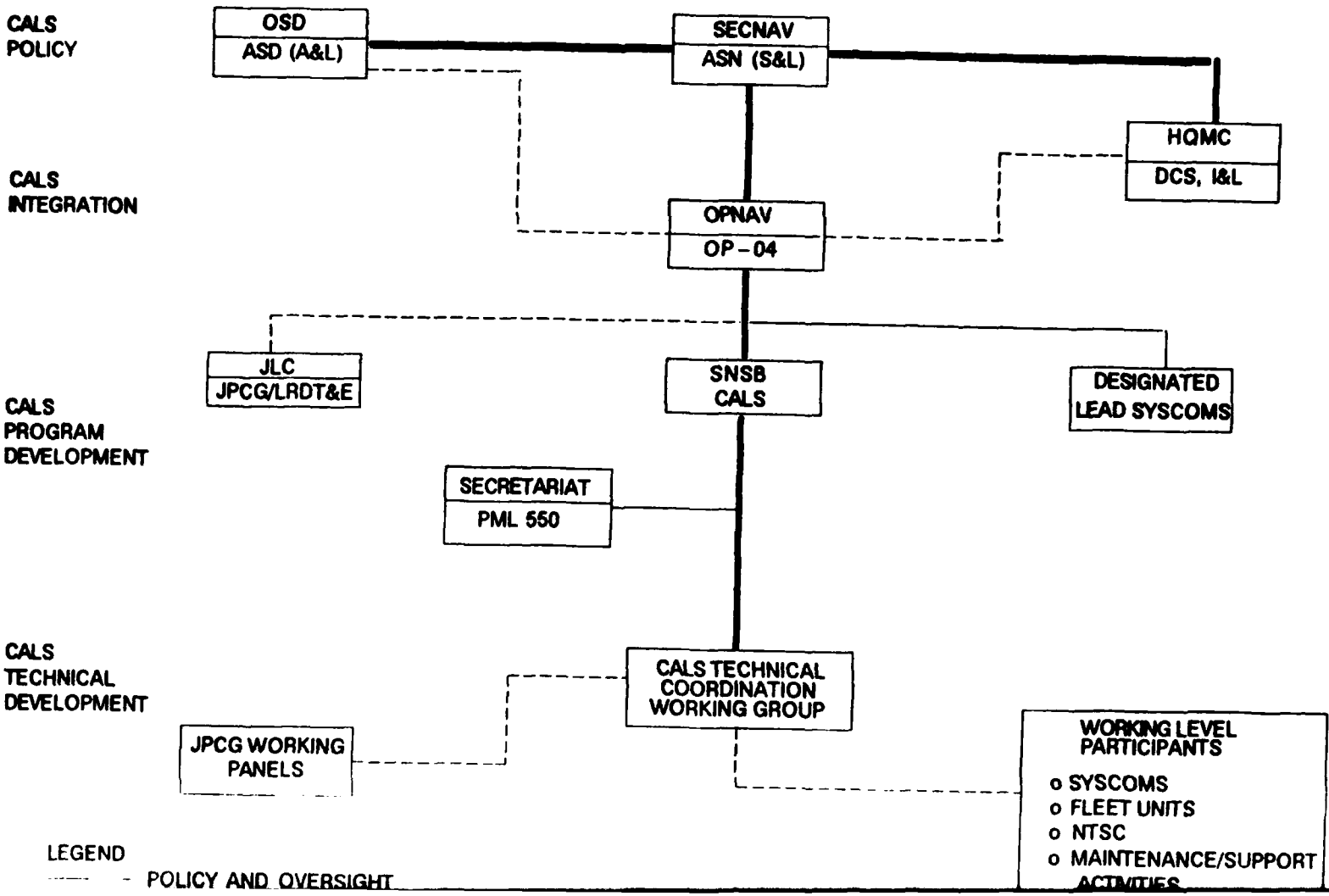
- o PROGRAM DEVELOPMENT
- o OPERATING SYSTEMS
- o PROGRAM LANGUAGES

A MINIMUM OF 29 STANDARDS APPLICABLE TO CALS

NATIONAL BUREAU OF STANDARDS
TAXONOMY OF LOGISTICS STANDARDS

Figure 1

NAVY CALS IMPLEMENTATION MANAGEMENT



GENERIC CALS OF THE FUTURE

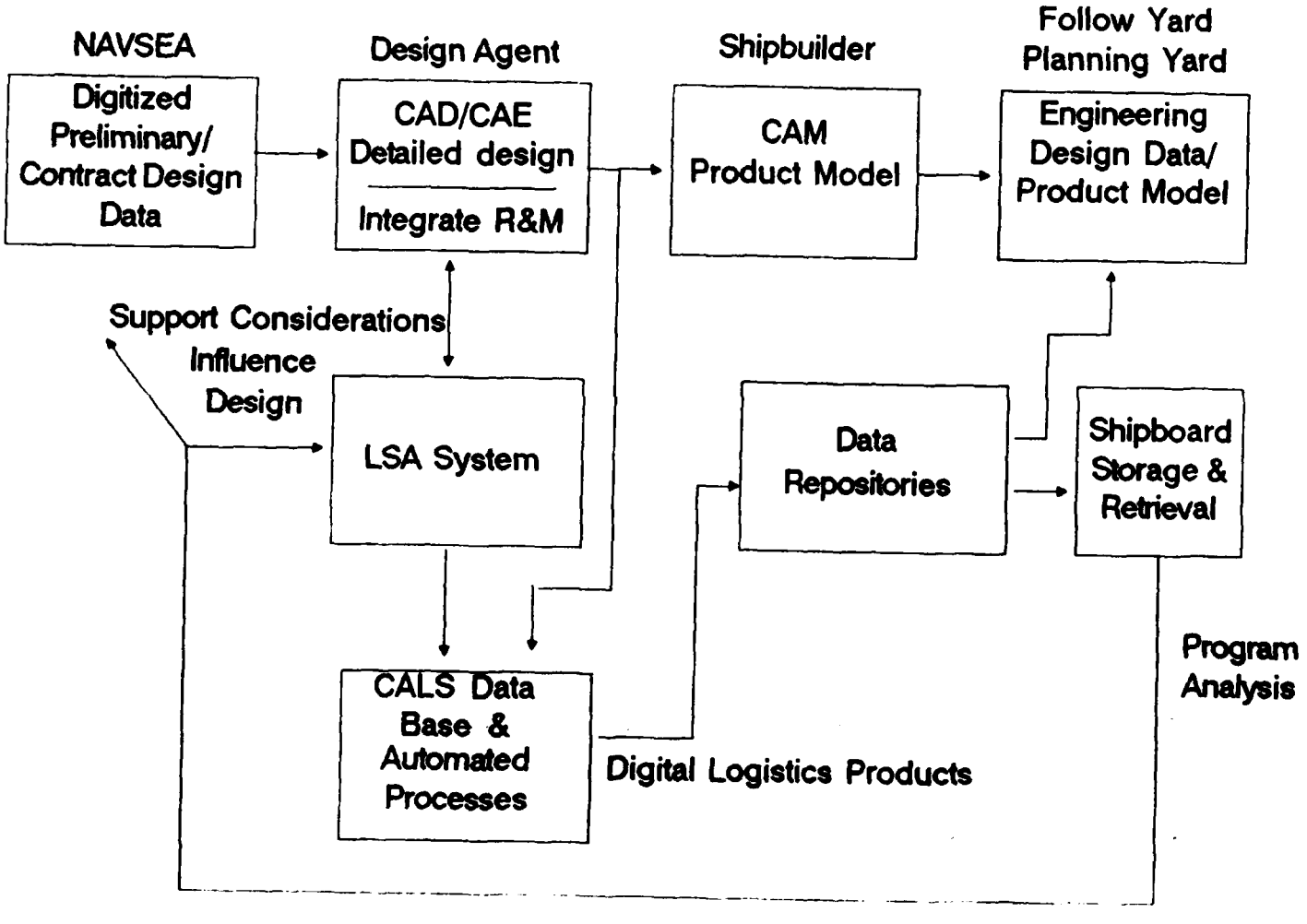
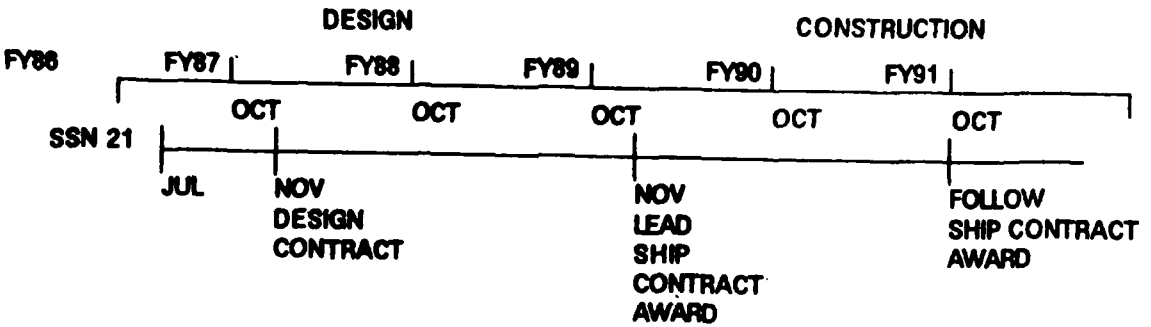


Figure 3

MILESTONES



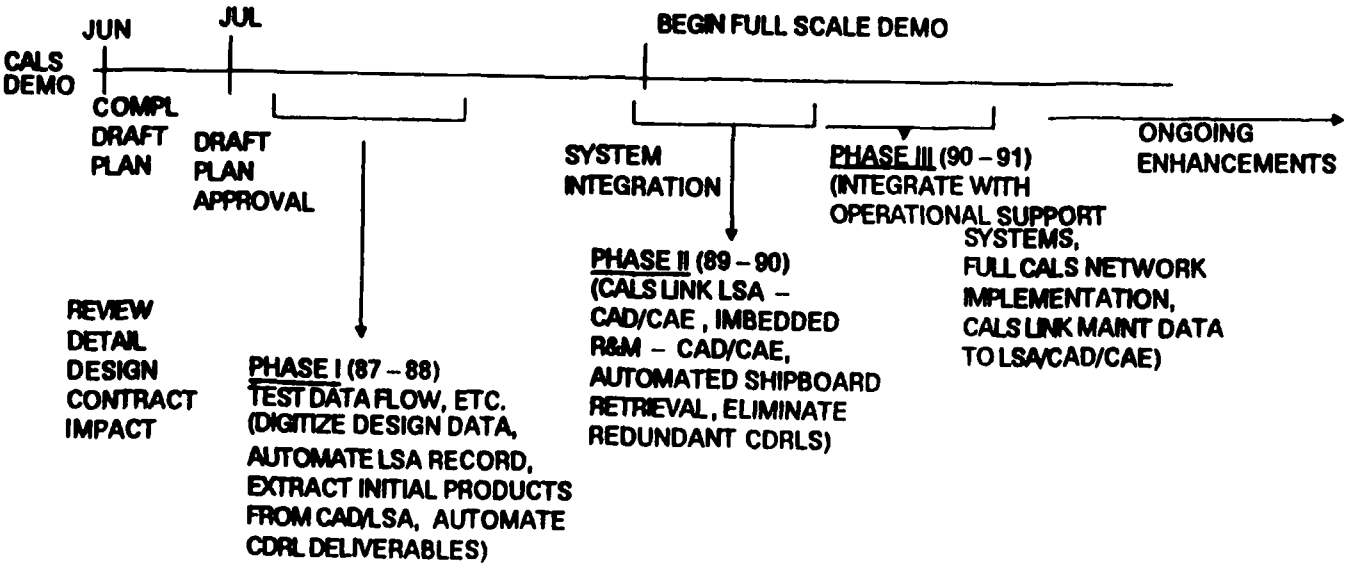


Figure 4

END

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